individual imaging aberrations of the respective sub-beam with respect to the desired target position and/or position the sub-beam during a writing process [an] on the substrate surface[.], and

F1 Cont'd

wherein for each sub-beam the respective aperture of the first of the at least one aperture plate defines the size and shape of the sub-beam cross-section and the multibeam optical system produced an image of said aperture on the substrate surface.

REMARKS

With respect to the objections to the drawings, applicant would appreciate learning from the Examiner or the Chief Drafstman what changes need to be made to the drawings to overcome the objections to the drawings.

In order to obtain a better delineation of the invention in claim1 against the prior art cited and applied by the Examiner, applicants have amended claim 1 to include the subject matter of claim 4. Consequentially, claim 4 has been cancelled.

The Examiner's rejection of claim 1 under 35 U.S.C. § 102 for being anticipated by, or under 35 U.S.C. § 103 for being unpatentable over, Ando *et al.* (U.S. No. 4,851,097), as these rejections may be attempted to be applied to the amended claim 1, is respectfully traversed.

In support of this traverse it is noted that Ando *et al.* discloses a multiple-imaging charged particle beam exposure system. The system (Fig. 7) comprises an ion beam source 1 generating an ion beam 201, an object aperture 3a, deflectors 4, a beam limiting aperture plate 31, an X-Y deflector system 32 and a screen lens 5, in the mentioned order (col.5, lin.16-24; col.7, lin.36-38). The object aperture 3a shapes the cross-section of the ion beam 201 so that images having the shape of the cross-section are formed on a workpiece 8 under each lens aperture of the screen lens (col.5, lin.41-44, 31). The beam limiting aperture plate 31 has a number of apertures 31a at locations corresponding to the lens apertures 5a of the screen lens 5, and serves to limit the ion beams to be passed through the lens apertures of the screen lens (col.7, lin.41-45). The X-Y deflector 32 can correct the focal positions of a plurality of ion beams individually and independently of each other. Further, the X-Y deflector is arranged between the aperture plate 31 and the screen lens 5 so that the magnetic field between the screen lens and the workpiece is not disturbed. As a result, it is possible to prevent focal deviation of the charged particle beams and

aberration or obscurity of images, which are liable to occur in the peripheral portion of the workpiece 8, and hence improve the writing accuracy as well as the production yield. (Col.8, lin.29-39).

The object of Ando *et al.* is the individual correction of the beams for a parallel multiple write process. The deflector 32 is used only for correcting imaging defects, but not for individual positioning of the beam on the workpiece (i.e., the substrate) for writing purposes. Indeed the writing process is done for the whole set of patterns to be produced on the target; this is done by means of the deflectors 4 which deflects the beam as a whole (cf. col.5, lin.25-29), i.e., before it is split into beam elements by the plate 31 (or the screen 5). There is no hint in this document pointing towards a positioning of the individual beams on the substrate as needed with a write process by means of the deflectors 4. A process wherein a multiplicity of possibly different patterns are written on the substrate is out of the scope of this document, which merely aims at an improvement of the parallel write process. Therefore, a person skilled in the art would not perceive any suggestion towards the invention, and Ando *et al.* do not teach or hint towards a device as claimed in claim 1.

Furthermore, according to Ando *et al.*, col.5, lin.41-44, the object aperture 3a shapes the cross-section of the ion-beam 201 so that images having the shape of the cross-section are formed on the workpiece 8. In the applicants' invention, however, it is the apertures of the first aperture plate that splits the ion-beam into a multitude of sub-beams that are imaged on the substrate surface; in the terminology of Ando *et al.*, these would be the apertures 5a of Ando's Fig. 5. A person skilled in the art would not attempt to replace, the imaging of object apertures 3a (which serves to produce identical images on the workpiece) in Ando's setup by an imaging of the apertures 5a since this would entail major modifications of the optical system.

Therefore, in view of the differences between the applicants' invention, as now defined even more clearly in amended claim 1, and Ando's teaching, the applicants believe that the invention according to amended claim 1 is new and non-obvious.

Also from the other prior art documents, a person skilled in the art cannot find any information or hints that would lead him toward the invention as described in applicants' application and now defined even more clearly in amended claim 1. In particular, applicants comment on the documents of Nakasugi *et al.*, Mankos and Le Poole as follows:

Nakasugi *et al.* (US 5,933,211) teaches a lithography apparatus with a multitude of charged beams, generated by a corresponding multitude of sources. The sources are imaged on the substrate (cf. Fig. 10). A deflection of the individual beams is only done in order to find the correct position of marks in the alignment process, but not for writing on the substrate. Thus, also this document cannot furnish any hints to the person skilled in the art which would direct him/her towards applicants' invention.

The applicants would like to stress that the "collimators" of Nakasugi *et al.* are devices completely distinct from the collimator as used in the applicants' invention. Applicants' collimator, in contrast, is a condenser lens means for forming the ion-beam generated by the ion source into a homogeneous and uniform broad beam. Nakasugi's "collimators" are mounted on electron detectors 6 in order to prevent the intrusion of reflected electrons from neighboring marks (Figs. 10 and 11; col.7 lin.15-22) and, thus, only have the name in common with the collimator of applicants' apparatus.

Mankos (US 6,157,039) uses beam splitters 104,106 to produce a set of particle beamlets, and a blanking aperture array (BAA) 108 to define which of the individual beamlets actually reach the writing plane (Fig.4; col.5 lin.14-18). A single conventional electromagnetic lens 124 focuses the beamlets in the plane of the BAA (col.4 lin.51-53). The imaging concept disclosed in this document is actually quite different from the parallel writing process as used in the invention. Whereas in Mankos's device an image is composed of an array of dots (each dot corresponding to a beam element) which are switched on or off as desired in order to produce one pattern on the substrate, the invention proposes a writing process wherein a plurality of beams is moved over the substrate surface and each beam produces its own pattern on the substrate. Already for this reason, the applicant is of the opinion that this document does not pertain to the relevant stat of the art, and a person skilled in the art would consider this document to refer to a distinctly different type of multi-beam structuring.

Furthermore, it is noteworthy that according to Mankos, the imaging of the beam onto the substrate is done with one optical system treating the beam as a whole in contrast to the multi-beam system according to the invention. Moreover, in this document demagnification of the image of the BAA mask is done as a whole, while in the invention each beam is focused individually. It follows that, in particular,

the values of demagnification given by Mankos are stated in a context completely different to the applicants' invention, so these numbers cannot be transferred to a device as proposed by the applicants.

Also the imaging concept of Le Poole (EP 0 087 196 A1) is quite different from that used in applicants' invention. By means of a complicated condenser optics elementary beams produced by a first beam splitter 18 from a divergent particle beam are directed parallel to the common axis 2 and focused in a matrix of deflection elements 26, then the beams are formed into a convergent beam bundle again which is focused again and then used to produce an image of desired size on the substrate (Fig. 1). An aperture plate 44 positioned after the optical system is used for spot-shaping. Imaging is only done with respect to the virtual beam source. In fact, to the applicants' opinion, as Le Poole proposes to use a common crossover geometry for definition of the overall size of the structure produced on the substrate, it actually teaches away from the invention.

According to the applicants, however, the total beam is first widened to the needed area and collimated so as to be parallel, and from this beam the individual sub-beams are formed an focused parallel. Thus, the beam-path geometry used by the applicants (as well as, e.g., Ando et al.), where there is sufficient space for optical elements for the individual beams after their shaping and directly before the substrate, is completely different from Le Poole's.

Upon reconsideration of the amended claims in view of the above arguments, it will be clear that the amended claims are non-obvious over the cited prior art. The Examiner's rejections of the claims dependent on claim 1 are thus rendered moot and the application should now be in condition for allowance. An early and favorable action to that end is requested.

Respectfully submitted,

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1. (Amended) An apparatus for multibeam lithography by means of electrically charged particles, comprising an illumination system having a particle source, the illumination system producing an illuminating beam of said electrically charged particles, and a multibeam optical system positioned after the illumination system as seen in the direction of the beam, said multibeam optical system comprising at least one aaperture plate having an array of a plurality of apertures to form a plurality of sub-beams, wherein the multibeam optical system focuses the sub-beams onto the surface of a substrate,

wherein for each sub-beam a deflection unit is provided, said deflection unit being positioned within the multibeam optical system and adapted to correct individual imaging aberations of the respective sub-beam with respect to the desired target position and/or position the sub-beam during a writing process on the substrate surface, and

wherein for each sub-beam the respective aperture of the first of the at least one aperture plate defines the size and shape of the sub-beam cross-section and the multibeam optical system produced an image of said aperture on the substrate surface.